CERTIFICATION THAT TRANSLATION IS TRUE AND ACCURATE

I, Tadashi UEDA, state that the translation attached hereto is a true and accurate translation of the attached Japanese Patent Application 2002-309649, filed on October 24, 2002.

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[Title of the Invention] DOUBLE-SIDED EMISSIVE LIQUID CRYSTAL DISPLAY MODULE

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[List of Documents Attached]

[Name of Document] Specification 1

[Name of Document] Drawings 1

[Name of Document] Abstract 1

[No. of General Power of Attorney] 9704956

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[Name of Document] SPECIFICATION

[Title of the Invention] DOUBLE-SIDED EMISSIVE LIQUID CRYSTAL DISPLAY MODULE

[Claims]

[Claim 1] A double-sided emissive liquid crystal display module comprising a double-sided illumination plate member; a first liquid crystal display panel disposed at the one surface of the double-sided illumination plate member; a second liquid crystal display panel disposed at the other surface of the double-sided illumination plate member;

characterized in that the double-sided illumination plate member includes a light source, a light guide plate for plane-emitting light introduced from the light source onto the one and the other surfaces, and a transflector disposed on a surface of the light guide plate facing the second liquid crystal display panel; and that the transflector reflects a part of the light emitted from the light guide plate toward the first liquid crystal display panel and transmits the rest of the light as white light toward the second liquid crystal display panel.

[Claim 2] The double-sided emissive liquid crystal display module according to Claim 1, wherein the double-sided illumination plate member emits greater than or equal to 70% and smaller than or equal to 90% of the amount of light from the one surface side, and emits greater than or equal to 10% and smaller than or equal to 30% of the amount of light from the other surface side.

[Claim 3] The double-sided emissive liquid crystal display

module according to 1 or 2, wherein the first liquid crystal display panel and the second liquid crystal display panel are transflective liquid crystal display panels.

[Claim 4] The double-sided emissive liquid crystal display module according to any one of Claims 1 to 3, wherein a prism sheet is disposed between the double-sided illumination plate member and the first liquid crystal display panel.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a double-sided emissive liquid crystal display module, and more particularly, to a double-sided emissive liquid crystal display module enabling effective use of light from a backlight.

[0002]

[Description of the Related Art]

In recent years, portable information terminal devices, such as cellular phones, PDAs, and portable terminals with a cellular phone function and the capability of displaying a large number of messages, have become widely available. These devices, in order to save power, often employs transflective liquid crystal display devices which operate in a reflective mode under bright lighting conditions, and operate using backlights, frontlights, and so on under poor lighting conditions they operate.

[0003]

In addition, among portable information terminal devices, cellular phones usually have a primary display portion for

displaying various information such as transmitted and received messages on the front face of a housing. Recently, a cellular phone that has an auxiliary display portion on the back face of the housing has become commercially available.

Figs. 6A and 6B show external schematic views of such a cellular phone. A cellular phone 301 shown in Figs. 6A and 6B consists of an upper housing 301a and a lower housing 301b that are connected with a hinge 301c enabling the phone to open and close freely, and a double-sided emissive liquid crystal display module is included in the upper housing 301a. The double-sided emissive liquid crystal display module is composed of a primary display unit having a primary display 301e exposed on an operating surface side 301d and an auxiliary display unit having an auxiliary display 301h exposed on an exterior surface back housing 301g.

An operating surface side 301j on the lower housing 302b is provided with a keyboard 301k for dialing and other operations.

[0004]

Fig. 7 shows the detailed structure of the double-sided emissive liquid crystal display module. As shown in Fig. 7, the double-sided emissive liquid crystal display module 302 is composed of a primary display unit 303 having the primary display surface 301e and an auxiliary display unit 304 having the auxiliary display surface 301h. The primary display unit 303 is composed of a transflective liquid crystal display panel 303a (hereinafter called a primary display panel) and a primary backlight 303b for illuminating the primary display

panel 303a, and the primary backlight 303b is composed of a light source 303c and a light guide plate 303d.

In addition, the auxiliary display unit 304 is composed of a transflective liquid crystal display panel 304a (hereinafter called an auxiliary display panel) smaller than the primary display panel 303a and an auxiliary backlight 304b for illuminating the auxiliary display panel 304a, and the auxiliary backlight 304b is composed of a light source 304c and a light guide plate 304d.

The primary backlight 303b and the auxiliary backlight 304b are composed of almost the same components (light sources 303c and 304c, and light guide plates 303d and 304d) except that they are different in size.

[0005]

According to the above cellular phone 301, even the housings 301a and 301b are folded together via the hinge 301c, the auxiliary display surface 301h is on the exterior side of the upper housing 301a. Thus, various information of the cellular phone 301 can be seen without opening the housings 301a and 301b.

[0006]

However, since the known cellular phone 301 includes both the primary backlight 303b and the auxiliary backlight 304b, there is a problem of requiring a large number of parts and a complicated internal structure, thus resulting in a thicker product.

Thus, focusing attention on the fact that the backlights 303b and 304b are composed of the same type of components, a

single backlight which combines the backlights for the primary display unit and the auxiliary display unit is proposed (see Patent Document 1).

[0007]

[Patent Document 1]

Japanese Unexamined Patent Application Publication No. 2000-338483

[0008]

[Problems to be Solved by the Invention]

The present invention is made in consideration of the above circumstances, and it is an object of the present invention to provide a double-sided emissive liquid crystal display module which requires a smaller number of components, has a simple internal structure, and enables effective use of light from a backlight.

[0009]

[Means for Solving the Problems]

To achieve the above object, the present invention employs the following structure.

The present invention provides a double-sided emissive liquid crystal display module including a double-sided illumination plate member; a first liquid crystal display panel disposed at the one surface of the double-sided illumination plate member; a second liquid crystal display panel disposed at the other surface of the double-sided illumination plate member; characterized in that the double-sided illumination plate member includes a light source, a light guide plate for plane-emitting light introduced from

the light source onto the one and the other surfaces, and a transflector disposed on a surface of the light guide plate facing the second liquid crystal display panel; and that the transflector reflects a part of the light emitted from the light guide plate toward the first liquid crystal display panel and transmits the rest of the light as white light toward the second liquid crystal display panel.

[0010]

The double-sided illumination plate member of the double-sided emissive liquid crystal display module includes a transflector for transmitting the light emitted from the light guide plate as white light toward the second liquid crystal display panel. Thus, the contrast of the second liquid crystal display panel can be enhanced.

Also, a single double-sided illumination plate member can illuminate both the first and second liquid crystal display panels. Thus, the number of components of the double-sided emissive liquid crystal display module can be reduced, resulting in a simplified structure.

Furthermore, since the transflector has no openings, when viewed from the first liquid crystal display panel, there may be no possibility that unevenness of the luminance is generated on the entire surface of the panel display surface, thus realizing favorable display quality.

[0011]

Also, the double-sided emissive liquid crystal display module of the present invention is a double-sided emissive liquid crystal display module as described previously,

wherein the double-sided illumination plate member emits greater than or equal to 70% and smaller than or equal to 90% of the amount of light from the one surface side, and emits greater than or equal to 10% and smaller than or equal to 30% of the amount of light from the other surface side.

[0012]

According to the double-sided emissive liquid crystal display module, since the amount of light emitted toward the one surface is in the range of greater than or equal to 70% and smaller than or equal to 90% of the total amount of emitted light, luminance of the first liquid crystal display panel can be enhanced. In particular, when the first liquid crystal display panel is used as a large primary liquid crystal display panel, the luminance of the entire panel display surface can be enhanced.

Also, since the amount of light emitted toward the other surface is greater than or equal to 10% and smaller than or equal to 30% of the total amount of emitted light, the luminance of the second liquid crystal display panel can be achieved, compared with a case in which no lighting means such as an illuminant is provided. In particular, when the second liquid crystal display panel is used as a small auxiliary liquid crystal display panel, a smaller absolute amount of light may be required, and enough luminance can be achieved even 10 to 30% of the amount of light.

[0013]

In addition, the double-sided emissive liquid crystal display module of the present invention is a double-sided

emissive liquid crystal display module as described previously, wherein the first liquid crystal display panel and the second liquid crystal display panel are transflective liquid crystal display panels.

[0014]

According to the double-sided emissive liquid crystal display module, since the first and second liquid crystal display panels are transflective, light emitted from the double-sided illumination plate member and external light entering from the outside of the module can both be used for display, so that high luminance and high contrast display can be achieved.

[0015]

Also, the double-sided emissive liquid crystal display module of the present invention is a double-sided emissive liquid crystal display module as described previously, wherein a prism sheet is disposed between the double-sided illumination plate member and the first liquid crystal display panel.

[0016]

According to the double-sided emissive liquid crystal display module, the luminance of the first liquid crystal display panel can be further enhanced.

[0017]

[Description of the Embodiments]

An embodiment of the present invention will now be described with reference to the drawings.

Fig. 1 is a side view of a double-sided emissive liquid

crystal display module according to an embodiment of the present invention; Fig. 2 is a side view of the main part of Fig. 1; and Fig. 3 is a schematic view illustrating the operation of the double-sided emissive liquid crystal display module.

As shown in Figs. 1 to 3, the double-sided emissive liquid crystal display module 1 of this embodiment includes a double-sided illumination plate member 2, a first liquid crystal display panel 10 that is disposed on the one surface 2a side of the double-sided illumination plate member 2, and a second liquid crystal display panel 20 that is disposed at the other surface 2b side of the double-sided illumination plate member 2.

[0018]

The double-sided illumination plate member 2 is composed of a substantially rectangular light guide plate 3, a light source 4 installed along one side end 3a of the light guide plate 3, and a transflector 30 disposed on a surface 3c (other surface), facing the second liquid crystal display panel 20, of the light guide plate 3.

[0019]

The light source 4 irradiates the one side end 3a of light guide plate 3 with light. Specific examples of the light source 4 are a white LED (light emitting diode) installed at one end or both ends of a rod-like light guide made of transparent resin, a plurality of white LEDs arranged along the one side end 3a of the light guide plate 3, and a rod-like cold cathode fluorescent tube (CCFT), etc.

The light guide plate 3 introduces light emitted from the light source 4 via the one end 3a, and then plane-emits the light toward both the one surface 3b (one surface 2a) and the other surface 3c (other surface 2b) of the plate 3, and is formed of a transparent resin material such as transparent acrylic resin, polycarbonate resin, epoxy resin, or glass. Acrylic resin is particularly suitable.

When the light guide plate 3 is used singly, amounts of light plane-emitted from the one surface 3b and the other surface 3c are in proportions of approximately 1:1.

[0020]

Next, the transflector 30 is a sheet-like member having both light reflecting and transmitting characteristics. It reflects a part of the light emitted from the other surface 3c of the double-sided illumination plate member 2 toward the first liquid crystal display panel 10, while it transmits the rest of the light as white light toward the second liquid crystal display panel 20. The transflector 30 is disposed between the double-sided illumination plate member 2 and the second liquid crystal display panel 20; more specifically, it is bonded to the entire surface of the other surface 3c of the light guide plate 3.

The thickness of the transflector 30 is between 50 μm and 125 μm, preferably 80 μm. The amount of light supplied toward the first liquid crystal display panel 10 and the second liquid crystal display panel 20 is controlled by the difference in reflectance of the transflector 30.

[0021]

An example of the transflector 30, shown in Fig. 4A, for example, includes a white layer 30a made of polyethylene terephthalate or the like, an adhesive layer 30b, and a reflective layer 30c made of polyolefins or the like. Another example, shown in Fig. 4B, is a white member made of highly reflective polyethylene terephthalate or the like.

[0022]

In addition, the double-sided illumination plate member 2 is configured such that it emits greater than or equal to 70% and smaller than or equal to 90% of the total amount of the light from the one surface 2a side, and emits greater than or equal to 10% and smaller than or equal to 30% from the other surface 2b side.

If the amount of light toward the first liquid crystal display panel 10 is less than 70%, the display of the panel 10 is dark, which is not preferable. If the amount of light toward the first liquid crystal display panel 10 exceeds 90%, the amount of light toward the second liquid crystal display panel 20 is so small that the display of the panel 20 is dark, which is not preferable.

These percentages of the amount of light are adjustable by the designs of the transflector 30 and the light guide plate 3. Specifically, by changing the reflectance of the transflector 30 or by roughening the one surface 3b or the other surface 3c of the light guide plate 3. To roughen the surfaces, embossing or grain finishing can be used.

If the one surface 3b or the other surface 3c of the light guide plate 3 is roughened, the light emitted from the

inside of the light guide is diffused by the roughness thereof, thus reducing the brightness. This effect is used for adjustment in such a way that roughening the one surface 3b reduces the amount of light transmitted toward the second liquid crystal display panel 20.

[0023]

In addition, it is preferable that the light emitted toward the second liquid crystal display panel 20 is white light. Since the light is used for illuminating the second liquid crystal display panel 20, colorless white light enhances the contrast on the display of the second liquid crystal display panel 20.

[0024]

Next, as shown in Fig. 1, the first liquid crystal display panel 10 is a substantially rectangular transflective liquid crystal display panel and is disposed to face most of the one surface 2a of the double-sided illumination plate member 2. The first liquid crystal display panel 10 is formed by bonding a first substrate 11 and a second substrate 12 that have a liquid crystal layer (not shown) sandwiched therebetween and are made of glasses or the like with a sealant. The surface opposite to the liquid crystal layer of the second substrate 12 is a display surface 10a. A transflector (not shown) and a display circuit (not shown) are laminated on the surface of the first substrate 11 facing the liquid crystal layer. A display circuit (not shown) is formed on the surface of the second substrate 12 facing the liquid crystal layer.

[0025]

The transflector included in the first liquid crystal display panel 10 transmits the light introduced from the double-sided illumination plate member toward the display surface 10a, and reflects external light entering from the display surface 10a. The transflector is formed, for example, by laminating a thin reflective film or by laminating a reflective film having many openings on the transparent substrate. In addition, the display circuit includes an electrode layer for driving the liquid crystal layer and an alignment layer, and in some cases, also includes a color filter.

[0026]

Next, the second liquid crystal display panel 20 is a transflective liquid crystal display panel which is substantially rectangular and smaller than the first liquid crystal display panel 10, and is disposed to face a part of the other surface 2b of the double-sided illumination plate member 2.

The second liquid crystal display panel 20 is formed by bonding a first substrate 21 and a second substrate 12 that have a liquid crystal layer (not shown) sandwiched therebetween and a made of glasses or the like with a sealant. The surface opposite to the liquid crystal layer of the second substrate 22 is a display surface 20a. A transflector (not shown) and a display circuit (not shown) are laminated on the surface of the first substrate 21 facing the liquid crystal layer, and a display circuit (not shown) is formed on

the surface of the second substrate 22 facing the liquid crystal layer. The transflector and the display circuits have the same compositions as those of the first liquid crystal display panel 10. Here, the transflector transmits the light introduced from the double-sided illumination plate member 2 toward the display surface 20a and reflects the external light entering from the display surface 20a.

[0027]

Further, as shown in Fig. 2, a light diffusion sheet 5 and prism sheets 6a and 6b are inserted between the one surface 2a of the double-sided illumination plate member 2 and the second substrate 11 of the first liquid crystal display panel 10. These sheets 5, 6a, and 6b are laminated over the one surface 2a of the double-sided illumination plate member 2. The light diffusion sheet 5 diffuses the light emitted from the one surface 2a to reduce unevenness of the luminance. In addition, the prism sheets 6a and 6b have a number of small prisms on their surface. The prism direction of the prism sheets 6a and that of the prism sheet 6b are orthogonal. The prism sheets 6a and 6b converge light within a specified viewing angle range, whereby the luminance within this range can be increased.

[0028]

In addition, a light diffusion sheet and a prism sheet may be disposed between the other surface 2c of the double-sided illumination plate member 2 and the second substrate 21 of the second liquid crystal display panel 20.

[0029]

Next, the operation of the double-sided emissive liquid crystal display module in this embodiment will now be described with reference to the drawings.

As shown in Fig. 3, light emerging from the light source 4 is introduced via the one end 3a into the light guide plate 3. Almost all of the introduced light is emitted from both the one surface 3b and the other surface 3c of the light guide plate. As shown by the arrow A, 70 to 90% of the emitted light is reflected by the transflector 30 to be emitted toward the first liquid crystal display panel 10.

In addition, 10 to 30% of the emitted light is transmitted through the transflector 30 as shown by the arrow B. Furthermore, a part of the transmitted light (the arrow C in the drawing) is introduced to the second liquid crystal display panel 20.

[0030]

The light transmitted through the transflector 30 is white light, and by using this white light for illuminating the second liquid crystal display panel 20, the contrast on the display of the second liquid crystal display panel 20 can be enhanced.

[0031]

Since the amount of light irradiated toward the first liquid crystal display panel 10 is in the range of greater than or equal to 70% and smaller than or equal to 90% of the total amount of emitted light, most of the emitted light can be irradiated to the first liquid crystal display panel 10, and luminance of the first liquid crystal display panel 10

can be increased. In particular, when the first liquid crystal display panel is used as a large primary liquid crystal display panel, the luminance of the entire display surface 10a can be enhanced.

[0032]

Also, since the amount of light irradiated toward the second liquid crystal display panel 20 is greater than or equal to 10% and smaller than or equal to 30% of the total amount of emitted light, the luminance of the second liquid crystal display panel 20 can be achieved, compared with a case in which no lighting means such as an illuminant is provided. In particular, when the second liquid crystal display panel 20 is used as a small auxiliary liquid crystal display panel, a smaller absolute amount of light may be required, and enough luminance can be achieved even 10 to 30% of the amount of light.

[0033]

In addition, since the first and second liquid crystal display panels 10 and 20 are transflective, light emitted from the double-sided illumination plate member 2 and external light entering from the outside of the module can both be used for display, so that high luminance and high contrast display can be achieved.

[0034]

In addition, the double-sided illumination plate member 2 can illuminate both the first liquid crystal display panel 10 and the second liquid crystal display panel 20, thereby reducing the number of components for the double-sided

emissive liquid crystal display module 1, thus simplifying the module's structure.

Furthermore, since the transflector 30 has no openings, when viewed from the first liquid crystal display panel 10, there may be no possibility that unevenness of the luminance is generated on the entire surface of the display surface 10a, thus realizing favorable display quality.

[0035]

The method for driving the first and second liquid crystal display panels 10 and 20 is not particularly limited. The method can be applied to active matrix type driving for which a thin-film transistor or a thin-film diode is used, or segment type driving in addition to simple matrix type driving. These liquid crystal display panels are included in the present invention.

[0036]

[Example]

A transflector having a thickness of 0.08 mm and reflectance of 97.5% was bonded on the other surface of a light guide plate to form a double-sided illumination plate member. After the light source was lit, the luminance was measured at the one and the other surfaces sides of the light guide plate. At the one surface side, the luminance was 3,300 cd/m^2, and 290 cd/m^2 at the other surface side, and a part of the light from the light source was emitted toward the other surface side.

Fig. 5 shows the wavelength dependence of the transflector reflectance.

[0037]

A color liquid crystal display panel with approximately 2% light transmittance was disposed at the one surface side of the light guide plate and a monochrome liquid crystal display panel with approximately 3% light transmittance was disposed at the other side.

Under these conditions, the luminance was measured at the surfaces of these liquid crystal display panels. At the color liquid crystal display panel, the luminance was 67 cd/m^2, while it was 9.7 cd/m^2 at the monochrome liquid crystal display panel. Both liquid crystal display panels provided enough contrast and visible displays.

[0038]

[Advantages]

As described above, the double-sided illumination plate member of the double-sided emissive liquid crystal display module of the present invention is provided with a transflector which transmits light emitted from the light guide plate as white light toward the second liquid crystal display panel. Therefore, the contrast of the second liquid crystal display can be enhanced.

Also, a single double-sided illumination plate member can illuminate both the first and second liquid crystal display panels. Thus, the number of components of the double-sided emissive liquid crystal display module can be reduced, resulting in a simplified structure.

Furthermore, since the transflector has no openings, when viewed from the first liquid crystal display panel 10,

there may be no possibility that unevenness of the luminance is generated on the entire surface of the panel display surface, thus realizing favorable display quality.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a side view showing the structure of a double-sided emissive liquid crystal display module which is an embodiment of the present invention.

[Fig. 2] Fig. 2 is a side view of the main part of Fig. 1.

[Fig. 3] Fig. 3 is a schematic view illustrating the double-sided emissive liquid crystal display module of the embodiment of the present invention.

[Fig. 4] Fig. 4 is a side schematic view showing the structure of a transflector.

[Fig. 5] Fig. 5 is a graph showing the wavelength dependence of the reflectance of the transflector.

[Fig. 6] Fig. 6 includes views showing one example of a known cellular phone; Fig. 6A is a perspective view as seen from the primary display side and Fig. 6B is a perspective view as seen from the auxiliary display side.

[Fig. 7] Fig. 7 is a side view showing a known double-sided emissive liquid crystal display module included in the cellular phone in Fig. 6.

[Reference Numerals]

1... double-sided emissive liquid crystal display module; 2... double-sided illumination plate member; 2a... one surface; 2b... other surface; 6a, 6b... prism sheets; 10... first liquid crystal display panel; 20... second liquid crystal display panel; 30... transflector

[Name of Document] ABSTRACT

[Abstract]

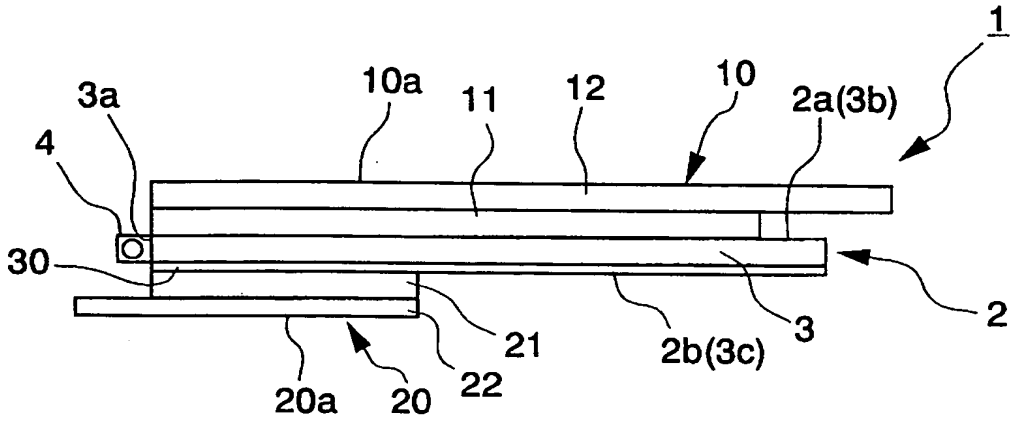
[Object] To provide a double-sided emissive liquid crystal display module which requires a smaller number of components, has a simple internal structure, and enables effective use of light from a backlight.

[Solving Means] A double-sided emissive liquid crystal display module 1 is adopted. The double-sided emissive liquid crystal display module includes a double-sided illumination plate member 2, a first liquid crystal display panel 10 disposed at the one surface 2a of the double-sided illumination plate member, a second liquid crystal display panel 20 disposed at the other surface 2b of the plate, and a transflector 30. The transflector 30 reflects a part of the light emitted from the other surface 2b toward the first liquid crystal display panel, while transmits the rest of the light as white light toward the second liquid crystal display panel 20.

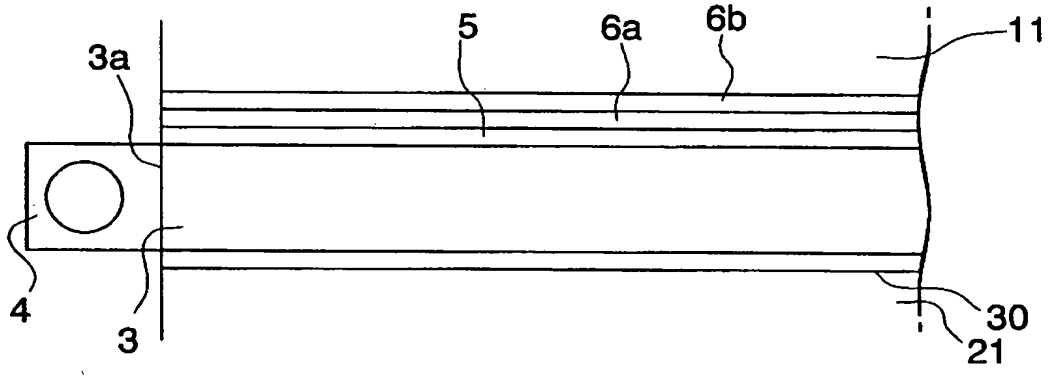
[Selected Figure] Fig. 1

【書類名】　図面 [Name of Document] DRAWINGS

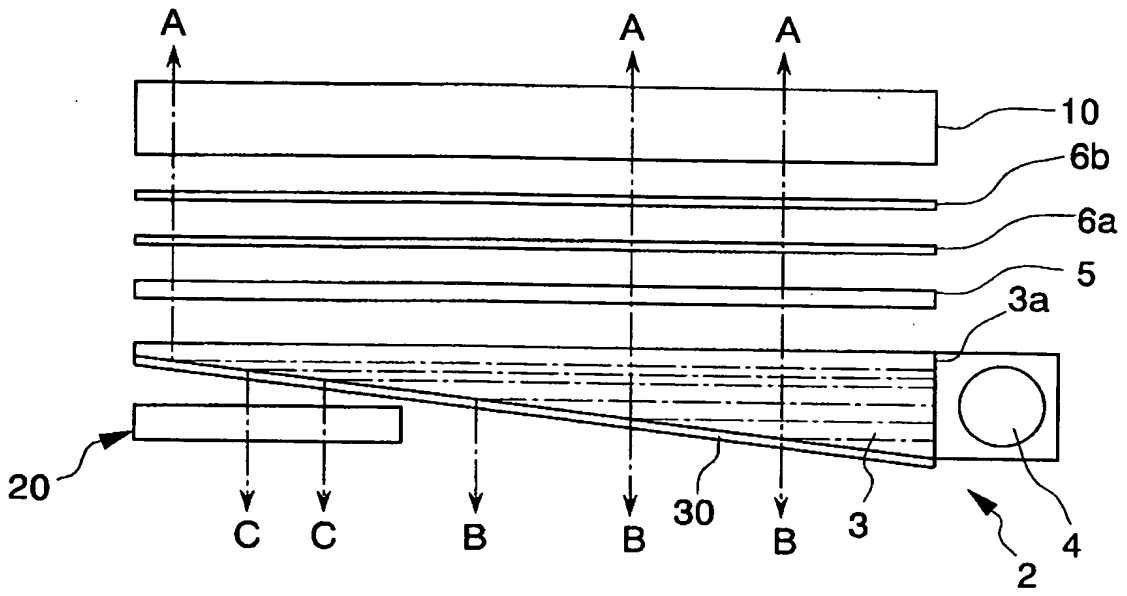
【図１】 [Fig. 1]



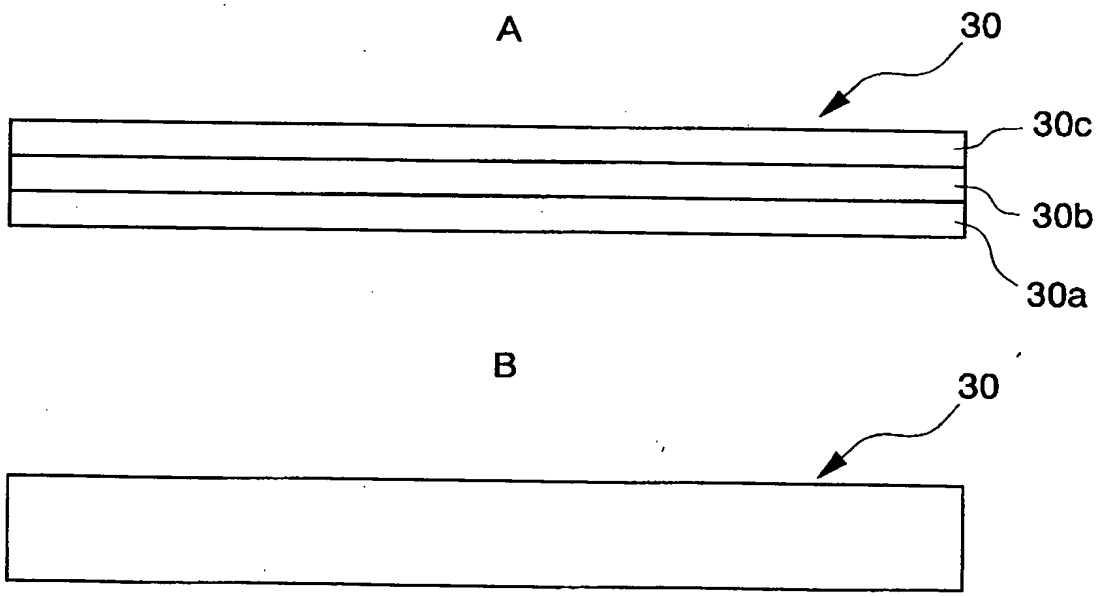
【図２】 [Fig. 2]



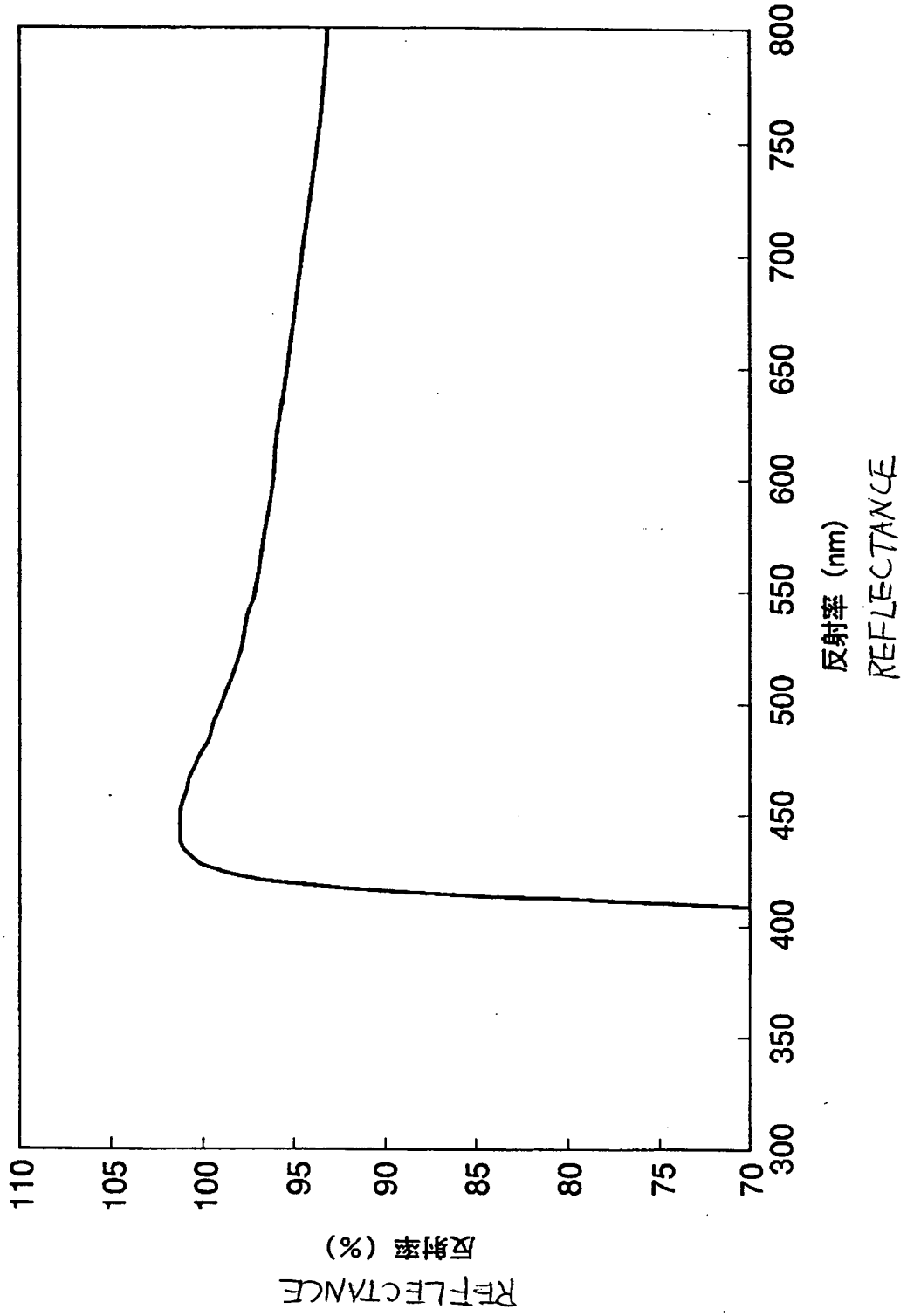
【図3】〔Fig.3〕



【図4】〔Fig.4〕



【図5】〔Fig.5〕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105
100
95
90
85
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75
70
反射率（%）
REFLECTANCE
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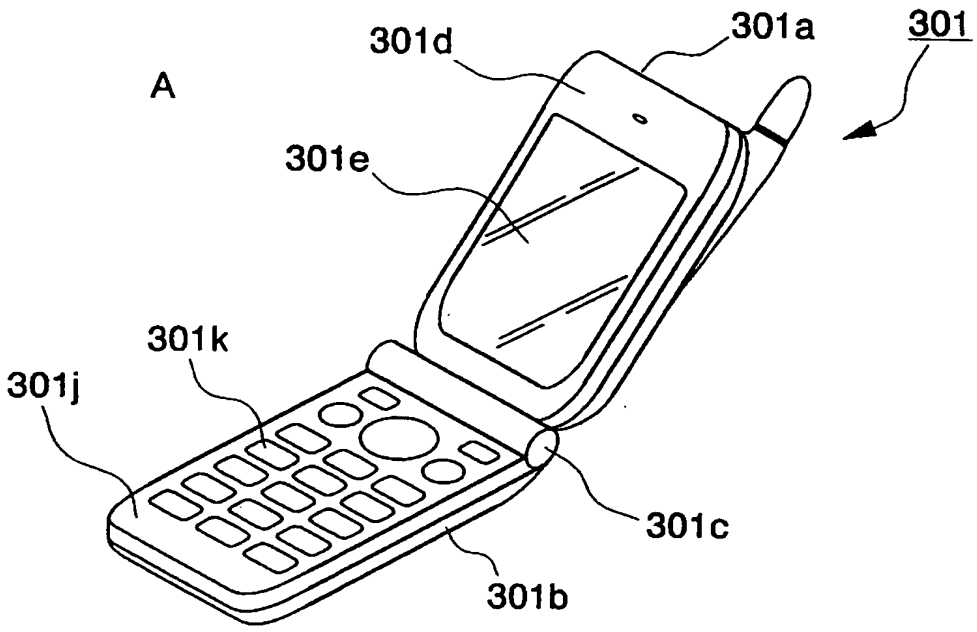
反射率（nm）
REFLECTANCE

【図6】[Fig. 6]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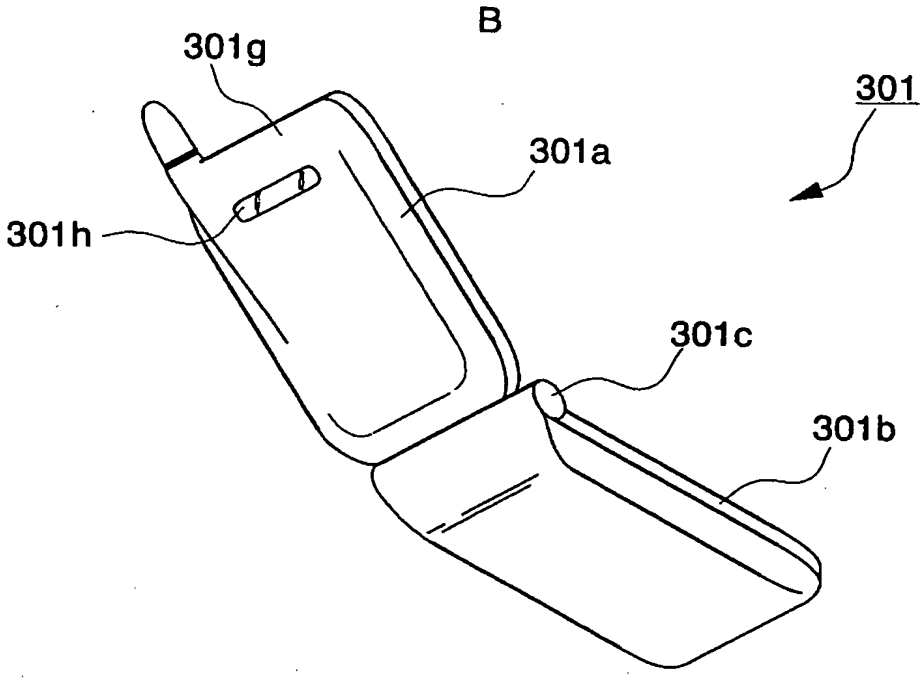
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301g
301
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301h
301c
301b

【図7】 [Fig. 7]